STRUCTURE, MICROSTRUCTURE AND ELECTRICAL PROPERTIES OF Tl-2212-SILVER COMPOSITE

BUREAU OF RESEARCH AND CONSULTANCY
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR
MALAYSIA

PREPARED BY:

FAIZAH MD. SALLEH
AHMAD KAMAL HAYATI BIN YAHYA

AUGUST 2001

CONTENTS

ABSTRACT

The relative effects of 5 wt. % Ag (in the form of Ag powder, Ag_2O and $AgNO_3$) addition on phase formation and superconductivity of Tl-2212 were studied. Samples were prepared using two different solid state synthesis routes: a) addition of 5 wt. % Ag to presynthesized Tl-2212 powder (PS samples) and b) premixing of 5 wt. % Ag to unreacted powders with starting composition of $Tl_2Ba_2CaCu_2O_8$ (PM samples). Final sintering for both samples were at 920 °C for 4-5 minutes in flowing oxygen. Resistance measurements of pure Tl-2212 showed $T_{c\ onset}$ ~ 112 K and $T_{c\ zero}$ of 95 K. For PS samples, addition of Ag showed little effect on T_c values. X-ray diffraction patterns of PS samples showed existence of dominant Tl-2212 phase along with small impurity phases. For PM samples, addition of Ag in the form of Ag powder and $AgNO_3$ showed a lowering of $T_{c\ zero}$ to around 70 K. In the case of Ag_2O the deterioration is severe and the sample was not superconducting down to 10 K. X-ray diffraction patterns of PM samples showed existence of Tl-2212 phase and a substantial amount of unreacted Tl_2O_3. Results of microstructural investigations using Scanning Electron Microscope and Vickers Microhardness measurements and their variation with the synthesis methods and the different forms of Ag-additives were also given.

CHAPTER I

INTRODUCTION

1.1 BACKGROUND ON SUPERCONDUCTIVITY

Superconductivity was discovered for the first time in 1911.[27] Dutch physicist at the University of Leiden, Kamerlingh Onnes acquired liquid helium at absolute temperature 4K by compressing helium gas. Using this liquid, he found that the electric resistance of Hg abruptly dropped near 4.2 K which is the boiling temperature of liquid helium. It is termed superconductivity that electric resistance does not exits at all. The variation of resistance with temperature for a superconductor and a normal conductor at low temperatures is show in Figure 1.1. The resistance of the superconductor drops abruptly to zero at the critical temperature *Tc*. The resistance is truly zero, not just merely very small as current induced in macroscopic superconducting materials persist indefinately without any diminution. However, it is known that if a current density, *J*, larger than the critical current density, *Jc*, is applied to the superconductor, superconductivity is destroyed.

Many other elements, compounds and alloys were soon found to be superconductors. Lead superconducts below 7.175 K. Tungsten becomes superconducting below 0.015 K while niobium becomes superconducting below 9.5 K. Later, dozens of other elements was found to superconduct. However, not all